

**CHI MEI**
OPTOELECTRONICS CORP.Issued Date: Oct. 28, 2004
Model No.: N154I1-L09 (NF4I109901)**Approval**

TFT LCD Approval Specification

MODEL NO.: N154I1-L09

Customer : _____ HP

Approved by : _____

Note :

Liquid Crystal Display Division	
QRA Division.	OA Head Division.
Approval	Approval
	<i>Wu Chao-Wen</i> 10/28/04 1200

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Approval

REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 3.0	Aug.13,2004	All	All	Approval specification first issued for HP.
Ver 3.1	Aug 17,2004	8	3.2	Modify the color of lamp wire LV from white to black
		10	4.2	Modify the color of lamp wire LV from white to black
Ver 3.2	Oct 28, 2004	4	1.5	Modify module weight from 625g(typ) to 600g(typ)
		13-15	5.5	Modify EDID for customer's request.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

N154I1 -L09 is a 15.4" TFT Liquid Crystal Display module with single CCFL Backlight unit and 30 pins LVDS interface. This module supports 1280 x 800 Wide-XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The inverter module for Backlight is not built in.

1.2 FEATURES

- Thin and light weight
- WXGA (1280 x 800 pixels) resolution
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	331.2 (H) x 207.0 (V) (15.4" diagonal)	mm	(1)
Bezel Opening Area	335.0 (H) x 210.7 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1280 x R.G.B. x 800	pixel	-
Pixel Pitch	0.2588 (H) x 0.2588 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (3H), Anti-glare (Haze 25)	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	343.5	344.0	344.5	mm	(1)
	Vertical(V)	221.5	222.0	222.5	mm	
	Depth(D)	-	6.2	6.5	mm	
Weight		-	600	620	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

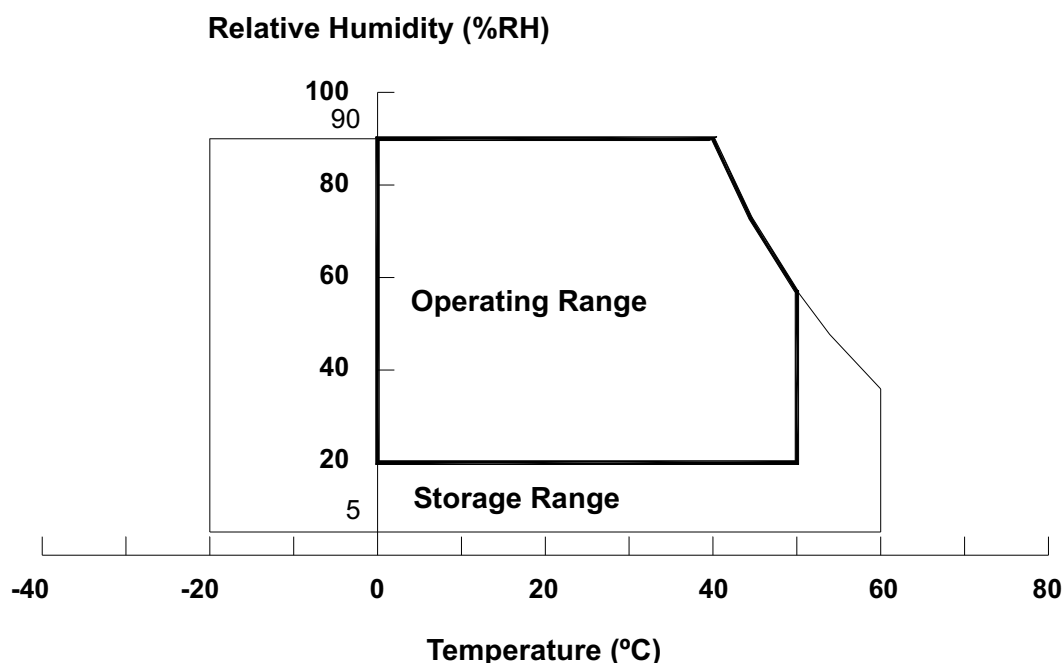
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)
Shock (Non-Operating)	S _{NOP}	-	220	G	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.5	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ($T_a \leq 40\text{ }^{\circ}\text{C}$).

(b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40\text{ }^{\circ}\text{C}$).

(c) No condensation .

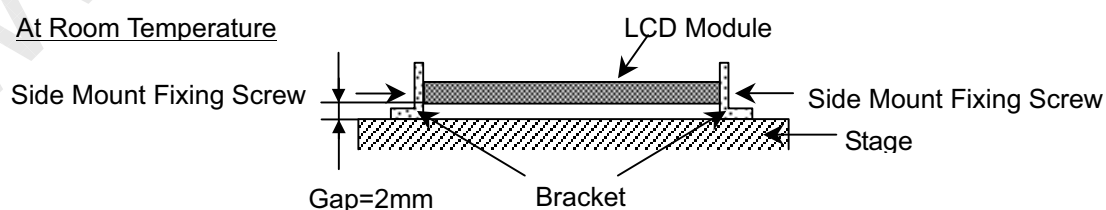


Note (2) The temperature of panel surface should be 0 °C Min. and 50 °C Max.

Note (3) 2ms, half sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$.

Note (4) 10 ~ 200 Hz, 0.5 Hr / Cycle, 1 cycles for each X, Y, Z. The fixing condition is shown as below:

At Room Temperature



Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	+4.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	V _{CC} +0.3	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V _L	-	2.5K	V _{RMS}	(1), (2), I _L = 6.5 mA
Lamp Current	I _L	-	7.0	mA _{RMS}	
Lamp Frequency	F _L	-	80	KHz	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to Section 3.2 for further information).

3. ELECTRICAL CHARACTERISTICS

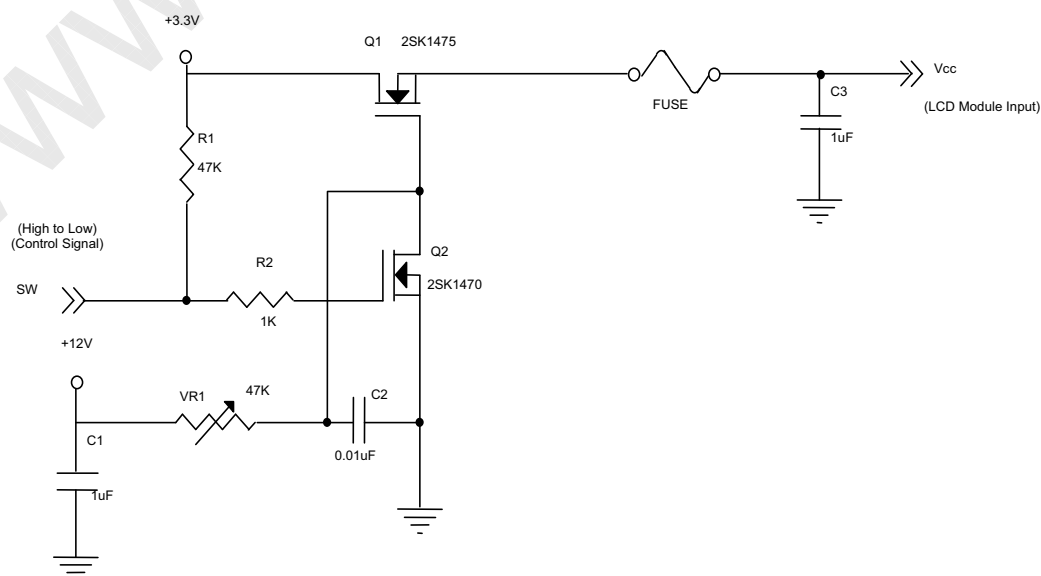
3.1 TFT LCD MODULE

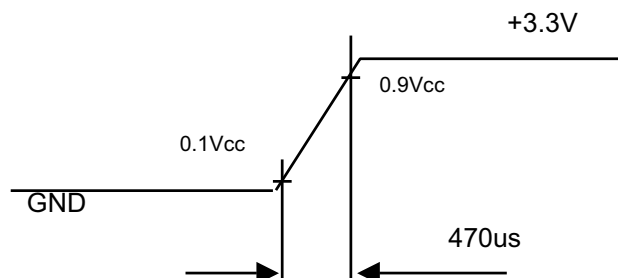
T_a = 25 ± 2 °C

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V _{CC}	3.0	3.3	3.6	V	-
Ripple Voltage		V _{RP}	-	-	100	mV	-
Rush Current		I _{RUSH}	-	-	1.5	A	(2)
Power Supply Current	White	I _{CC}	-	580		mA	(3)a
	Black		-	650		mA	(3)b
	Vertical Stripe		-	650		mA	(3)c
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V _{IH}	-	-	+100	mV	-
	"L" Level	V _{IL}	-100	-	-	mV	-
Terminating Resistor		R _T	-	100	-	Ohm	-

Note (1) The module should be always operated within above ranges.

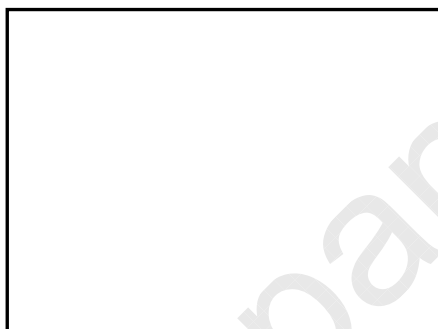
Note (2) Measurement Conditions:



Vcc rising time is 470us

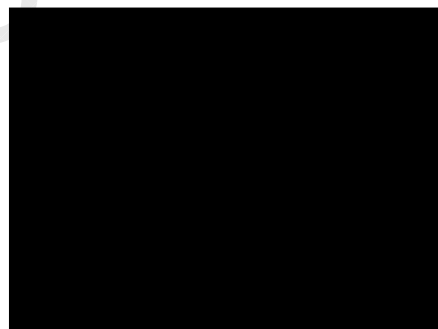
Note (3) The specified power supply current is under the conditions at $V_{cc} = 3.3\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, DC Current and $f_v = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



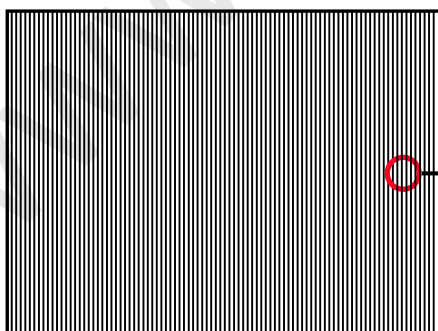
Active Area

b. Black Pattern

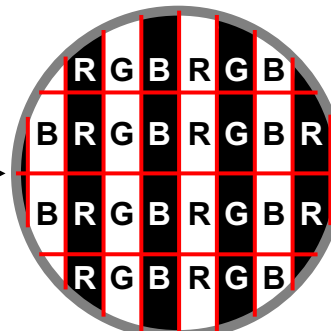


Active Area

c. Vertical Stripe Pattern



Active Area

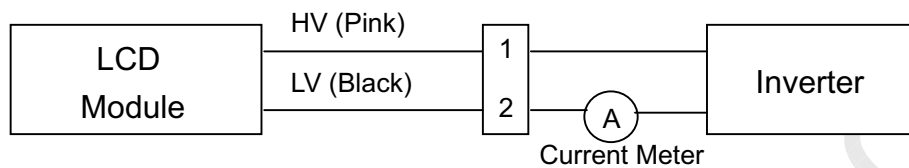


3.2 BACKLIGHT UNIT

 $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	585	650	715	V_{RMS}	$I_L = 6.5\text{ mA}$
Lamp Current	I_L	2.0	6.5	7.0	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	-	-	1230, 25 $^{\circ}\text{C}$	V_{RMS}	(2)
		-	-	1530, 0 $^{\circ}\text{C}$	V_{RMS}	(2)
Operating Frequency	F_L	50	-	80	KHz	(3)
Lamp Life Time	L_{BL}	10,000	-	-	Hrs	(5)
Power Consumption	P_L	-	4.22	-	W	(4), $I_L = 6.5\text{ mA}$

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:



Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may generate interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp is defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ and $I_L = 6.5\text{ mA}_{RMS}$ until one of the following events occurs:

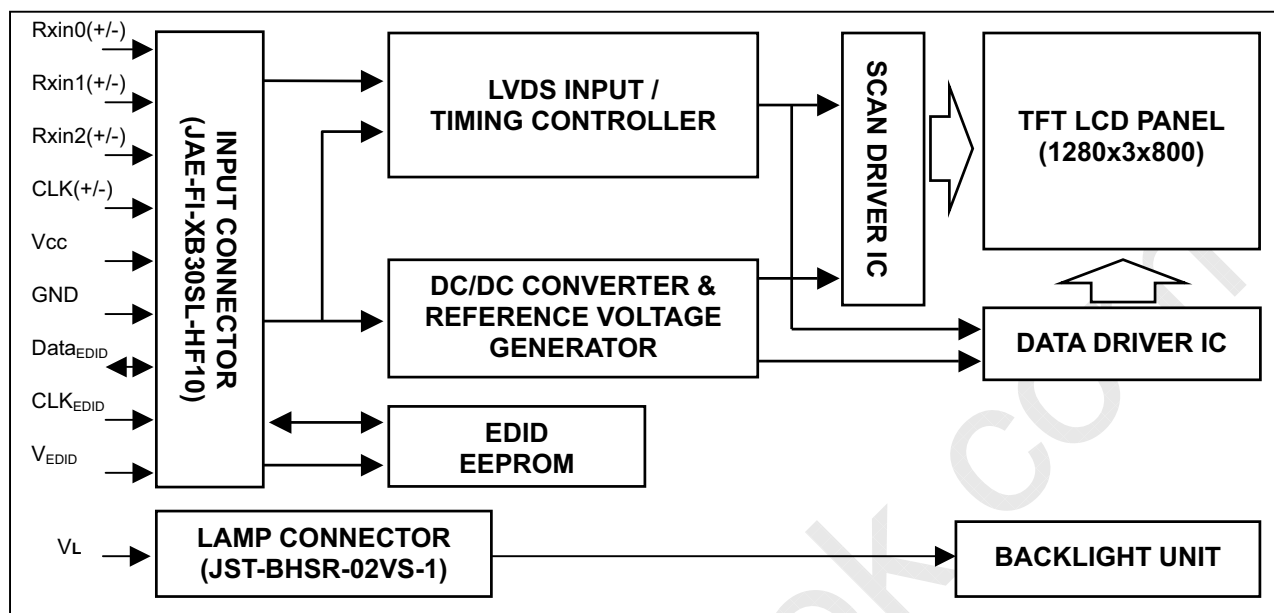
(a) When the brightness becomes $\leq 50\%$ of its original value.

(b) When the effective ignition length becomes $\leq 80\%$ of its original value. (Effective ignition length is defined as an area that the brightness is less than 70% compared to the center point.)

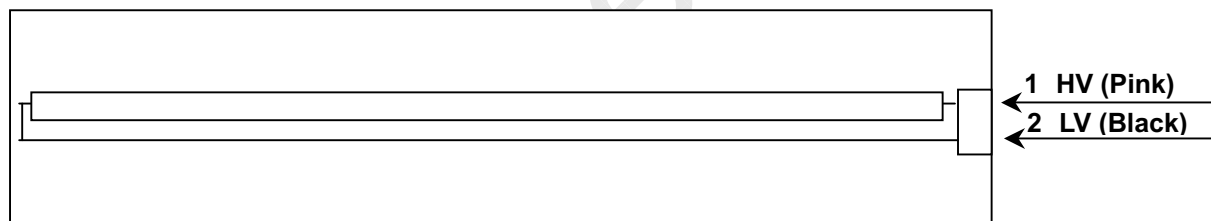
Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid generating too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACKLIGHT UNIT





5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	Vss	Ground		-
2	Vcc	Power Supply +3.3 V		-
3	Vcc	Power Supply +3.3 V		-
4	V _{EDID}	DDC +3.3 V		
5	NC	-	-	-
6	CLK _{EDID}	DDC Clock		
7	Data _{EDID}	DDC Data		
8	Rxin0-	LVDS Differential Data Input	Negative	- R0~R5,G0
9	Rxin0+	LVDS Differential Data Input	Positive	
10	Vss	Ground		
11	Rxin1-	LVDS Differential Data Input	Negative	- G1~G5,B0,B1
12	Rxin1+	LVDS Differential Data Input	Positive	
13	Vss	Ground		
14	Rxin2-	LVDS Differential Data Input	Negative	- B2~B5,Hsync,Vsync,DE
15	Rxin2+	LVDS Differential Data Input	Positive	
16	Vss	Ground		
17	CLK-	LVDS Clock Data Input	Negative	LVDS Level
18	CLK+	LVDS Clock Data Input	Positive	
19	Vss	Ground		
20	NC	-	-	-
21	NC	-	-	-
22	NC	-	-	-
23	NC	-	-	-
24	NC	-	-	-
25	NC	-	-	-
26	NC	-	-	-
27	NC	-	-	-
28	NC	-	-	-
29	NC	-	-	-
30	NC	-	-	-

Note (1) Connector Part No.: JAE-FI-XB30SL-HF10 or equivalent

Note (2) User's connector Part No: JAE-FI-X30C2L or equivalent

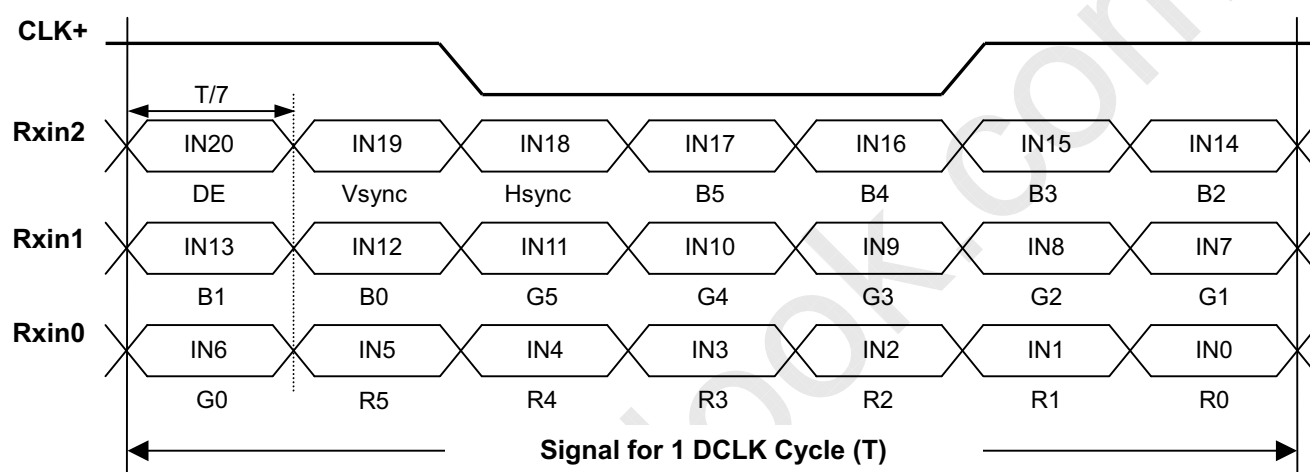
5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	Pink
2	LV	Ground	Black

Note (1) Connector Part No.: JST-BHSR-02VS-1 or equivalent

Note (2) User's connector Part No.: JST-SM02B-BHSS-1-TB or equivalent

5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
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	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

5.5 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPD1 standards.

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	0	Header , Fixed	00	00000000
1	1	Header , Fixed	FF	11111111
2	2	Header , Fixed	FF	11111111
3	3	Header , Fixed	FF	11111111
4	4	Header , Fixed	FF	11111111
5	5	Header , Fixed	FF	11111111
6	6	Header , Fixed	FF	11111111
7	7	Header , Fixed	00	00000000
8	8	EISA Mfg. Code LSB 3 character in compressed ASCII: "CMO" -> 0D AF	0D	00001101
9	9	EISA Mfg. Code LSB 3 character in compressed ASCII: "CMO" -> 0D AF	AF	10101111
10	0A	Product code 1500, (hex, LSB first)	04	00000000
11	0B	Product code 1500, (hex, LSB first)	15	00010101
12	0C	32-bit serial # Unused(01h for VESA, 00h for SPWG)	00	00000000
13	0D	32-bit serial # Unused(01h for VESA, 00h for SPWG)	00	00000000
14	0E	32-bit serial # Unused(01h for VESA, 00h for SPWG)	00	00000000
15	0F	32-bit serial # Unused(01h for VESA, 00h for SPWG)	00	00000000
16	10	Week of manufacture 1 - 53 (unused: 00h) : 02h fixed by CMO	02	00000010
17	11	Year of manufacture year - 1990(unsed:00h) : 0Dh (Year 2003) fixed by CMO	0D	00001101
18	12	Version=1	01	00000001
19	13	Revision=3	03	00000011
20	14	Digital	80	10000000
21	15	Active area horizontal 33.12cm	21	00100001
22	16	Active area vertical 20.70cm	15	00010101
23	17	gamma * 100-100 = 2.2*100-100=120	78	01111000
24	18	Feature support (no DPMS, Active off, RGB, Preferred Timing Mode)	0A	00001010
25	19	Rx1 Rx0 Ry1 Ry0 Gx1 Gx0 Gy1 Gy0	CA	11001010
26	1A	Bx1 Bx0 By1 By0 Wx1 Wx0 Wy1 Wy0	A5	10100101
27	1B	Rx=0.585	95	10010101
28	1C	Ry=0.355	5B	01011011
29	1D	Gx=0.299	4C	01001100
30	1E	Gy=0.584	95	10010101
31	1F	Bx=0.154	27	00100111
32	20	By=0.135	22	00100010
33	21	Wx=0.313	50	01010000
34	22	Wy=0.329	54	01010100
35	23	Not supported	00	00000000
36	24	Not supported	00	00000000
37	25	No manufacturer's specific timing	00	00000000
Byte #	Byte #	Field Name and Comments	Value	Value

(decimal)	(hex)		(hex)	(binary)
38	26	01h: Blank	01	00000001
39	27	01h: Blank	01	00000001
40	28	01h: Blank	01	00000001
41	29	01h: Blank	01	00000001
42	2A	01h: Blank	01	00000001
43	2B	01h: Blank	01	00000001
44	2C	01h: Blank	01	00000001
45	2D	01h: Blank	01	00000001
46	2E	01h: Blank	01	00000001
47	2F	01h: Blank	01	00000001
48	30	01h: Blank	01	00000001
49	31	01h: Blank	01	00000001
50	32	01h: Blank	01	00000001
51	33	01h: Blank	01	00000001
52	34	01h: Blank	01	00000001
53	35	01h: Blank	01	00000001
54	36	Pixel clock/10000(LSB first)	BC	10111100
55	37	71MHz/10000 = 7100 = 1BBCh	1B	00011011
56	38	HActive(D7-D0) = 1280 mod 256	00	00000000
57	39	HBlank(D7-D0) = 160 mod 256	A0	10100000
58	3A	HActive(D11-D8) : HBlank(D11-D8) = 1280/256 : 160/256	50	01010000
59	3B	VActive(D7-D0) = 800 mod 256	20	00100000
60	3C	VBlank(D7-D0) = 23 mod 256	17	00010111
61	3D	VActive(D11-D8) : VBlank(D11-D8) = 800/256 : 23/256	30	00110000
62	3E	HSyncOffset(D7-D0) = HBorder+HFrontPorch = 48	30	00110000
63	3F	HSyncWidth(D7-D0) = 32	20	00100000
64	40	VSynOffset(D3-D0) : VSynWidth(D3-D0)	26	00100110
65	41	HSyncOffset(D9-D8) : HSyncWidth(D9-D8) : VSynOffset(D5-D4) : VSynWidth(D5-D4)	00	00000000
66	42	HImageSize(mm, D7-D0) = 331 mod 256	4B	01001011
67	43	VImageSize(mm, D7-D0) = 207 mod 256	CF	11001111
68	44	HImageSize(D11-D8) : VImageSize(D11-D8) = 331/256 : 207/256	10	00010000
69	45	Hborder=0	00	00000000
70	46	Vborder=0	00	00000000
71	47	Non-interlaced, Normal Display, Digital separate, Positive Hsync, Negative Vsync	1C	00011100
72	48	Detailed timing description # 2	00	00000000
73	49	# 2 Flag	00	00000000
74	4A	# 2 Reserved	00	00000000
75	4B	# 2 FE (hex) defines ASCII string (Model Name "N154I1", ASCII)	FE	11111110
76	4C	# 2 Flag	00	00000000
77	4D	# 2 1 st character of string ("N")	4E	01001110
78	4E	# 2 2 nd character of string ("1")	31	00110001
79	4F	# 2 3 rd character of string ("5")	35	00110101
80	50	# 2 4 th character of string ("4")	34	00110100
81	51	# 2 5 th character of string ("1")	49	01001001
Byte #	Byte #	Field Name and Comments	Value	Value

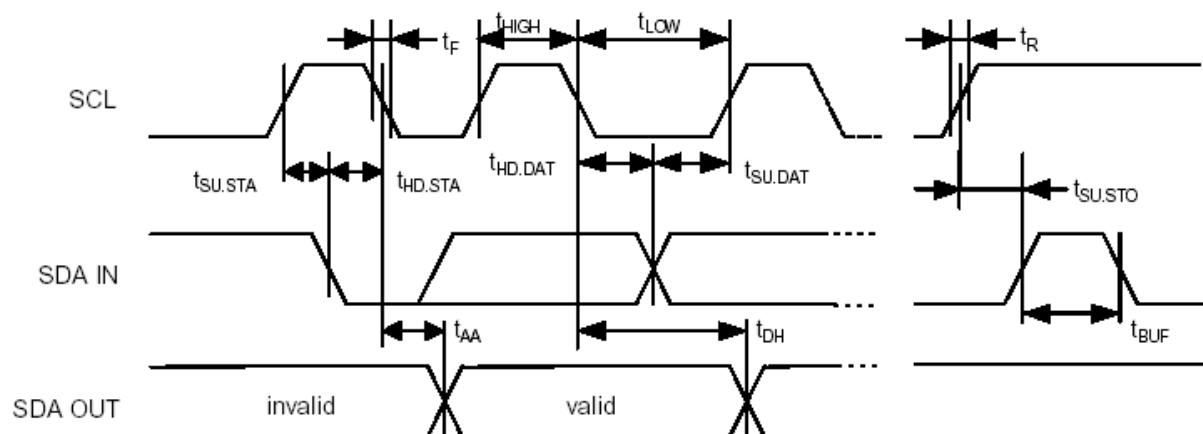


(decimal)	(hex)		(hex)	(binary)
82	52	# 2 6 th character of string ("1")	31	00110001
83	53	# 2 New line character # 2 indicates end of ASCII string	0A	00001010
84	54	# 2 Padding with "Blank" character	20	00100000
85	55	# 2 Padding with "Blank" character	20	00100000
86	56	# 2 Padding with "Blank" character	20	00100000
87	57	# 2 Padding with "Blank" character	20	00100000
88	58	# 2 Padding with "Blank" character	20	00100000
89	59	# 2 Padding with "Blank" character	20	00100000
90	5A	Detailed timing description # 3	00	00000000
91	5B	# 3 Flag	00	00000000
92	5C	# 3 Reserved	00	00000000
93	5D	# 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# 3 1 st character of string ("C")	43	01000011
96	60	# 3 2 nd character of string ("M")	4D	01001101
97	61	# 3 3 rd character of string ("O")	4F	01001111
98	62	# 3 New line character # 3 indicates end of ASCII string	0A	00001010
99	63	# 3 Padding with "Blank" character	20	01011000
100	64	# 3 Padding with "Blank" character	20	00100000
101	65	# 3 Padding with "Blank" character	20	00100000
102	66	# 3 Padding with "Blank" character	20	00100000
103	67	# 3 Padding with "Blank" character	20	00100000
104	68	# 3 Padding with "Blank" character	20	00100000
105	69	# 3 Padding with "Blank" character	20	00100000
106	6A	# 3 Padding with "Blank" character	20	00100000
107	6B	# 3 Padding with "Blank" character	20	00100000
108	6C	Detailed timing description # 4	00	00000000
109	6D	# 4 Flag	00	00000000
110	6E	# 4 Reserved	00	00000000
111	6F	# 4 FC (hex) defines Monitor name (Model Name"N154I1-L09", ASCII)	FC	11111100
112	70	# 4 Flag	00	00000000
113	71	# 4 1 st character of name ("N")	4E	01001110
114	72	# 4 2 nd character of name ("1")	31	00110001
115	73	# 4 3 rd character of name ("5")	35	00110101
116	74	# 4 4 th character of name ("4")	34	00110100
117	75	# 4 5 th character of name ("I")	49	01001001
118	76	# 4 6 th character of name ("1")	31	00110001
119	77	# 4 7 th character of name ("-")	2D	00101101
120	78	# 4 8 th character of name ("L")	4C	01001100
121	79	# 4 9 th character of name ("0")	30	00110000
122	7A	# 4 9 th character of name ("9")	39	00111001
123	7B	# 4 New line character # 4 indicates end of ASCII string	0A	00001010
124	7C	# 4 Padding with "Blank" character	20	00100000
125	7D	# 4 Padding with "Blank" character	20	00100000
126	7E	Extension flag	00	00000000
127	7F	One-byte checksum of entire 128 bytes EDID equals 00h.	04	00001000

5.6 EDID SIGNAL SPECIFICATION

(1) EDID Power

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	—	2.7	—	5.5	V



(2) DC characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply current Vcc=5.0V	Icc	READ at 100kHz	—	0.4	1.0	mA
Supply current Vcc=5.0V	Icc	WRITE at 100kHz	—	2.0	3.0	mA
Standby Current	ISB	Vin=Vcc or Vss	—	1.6	4.0	μA
Input Leakage Current	ILI	Vin=Vcc or Vss	—	0.1	3.0	μA
Onput Leakage Current	ILO	Vout=Vcc or Vss	—	0.05	3.0	μA
Input Low Level	VIL	—	-1.0	—	Vcc x 0.3	V
Input High Level	VIH	—	Vcc x 0.7	—	Vcc+0.5	V
Output Low Level Vcc=1.8V	VOL1	IOL=0.15mA	—	—	0.2	V
Output Low Level Vcc=3.0V	VOL2	IOL=2.1mA	—	—	0.4	V

(3) AC characteristics (VCC=2.5~5.5V standard operation mode)

Parameter	Symbol	Min	Max	Unit
Clock Frequency, SCL	F _{SCL}	—	100	kHz
Clock Pulse Width Low	T _{LOW}	4.7	—	μs
Clock Pulse Width High	T _{HIGH}	4.0	—	μs
Noise Suppression Time	T _I	—	100	ns
Clock Low to Data Out Valid	T _{AA}	0.1	4.5	μs
Time the bus must be free before a new transmission can start	T _{BUF}	4.7	—	μs
Start Hold Time	T _{HD.STA}	4.0	—	μs
Start Set-up Time	T _{SU.STA}	4.7	—	μs
Data in Hold Time	T _{HD.DAT}	0	—	μs
Data in Set-up Time	T _{SU.DAT}	200	—	ns
Inputs Rise Time	T _R	—	1.0	μs
Inputs Fall Time	T _F	—	300	ns
Stop Set-up Time	T _{SU.STO}	4.7	—	μs
Data Out Hold Time	T _{DH}	100	—	ns
Write Cycle Time	T _{WR}	—	10	ms

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

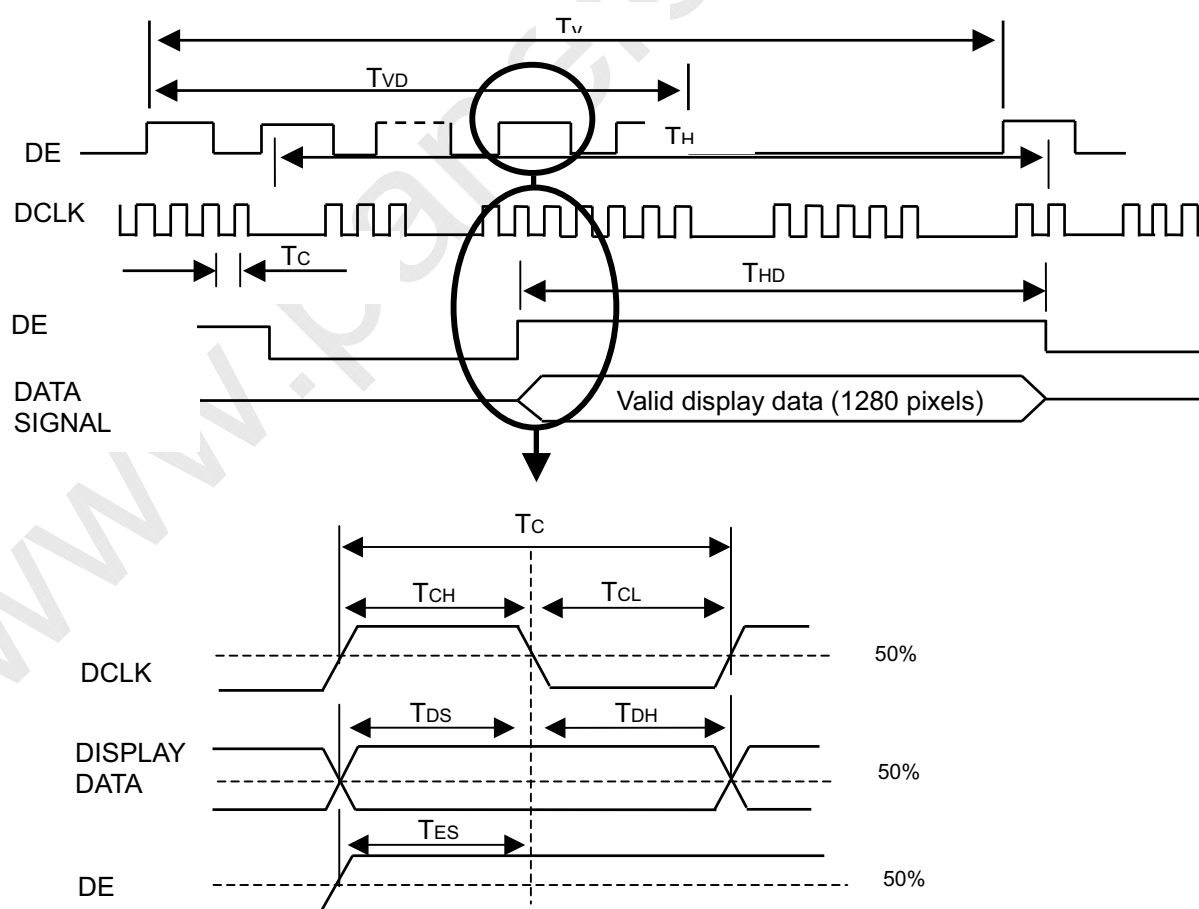
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	$1/T_c$	-	71	80	MHz	-
	High Time	T_{CH}	13	-	-	nsec	-
	Low Time	T_{CL}	13	-	-	nsec	-
Data	Setup Time	T_{DS}	4	-	-	nsec	-
	Hold Time	T_{DH}	4	-	-	nsec	-
Vsync Frequency	Frequency	Vsync	-	60	-	Hz	-
Hsync Frequency	Frequency	Hsync	-	49.4	-	KHz	-
Data Enable	Pulse width	T_{DEP}	100	-	-	clocks	(1)
Data Enable	Setup Time	T_{ES}	3.5	4.0	-	nsec	(1)
Frame Frequency	Cycle	T_v	810	823	2000	lines	-
Vertical Active Display Term	Display Period	T_{VD}	800	800	800	lines	-
One Line Scanning Time	Cycle	T_H	1360	1440	2000	clocks	(2)
Horizontal Active Display Term	Display Period	T_{HD}	1280	1280	1280	clocks	-

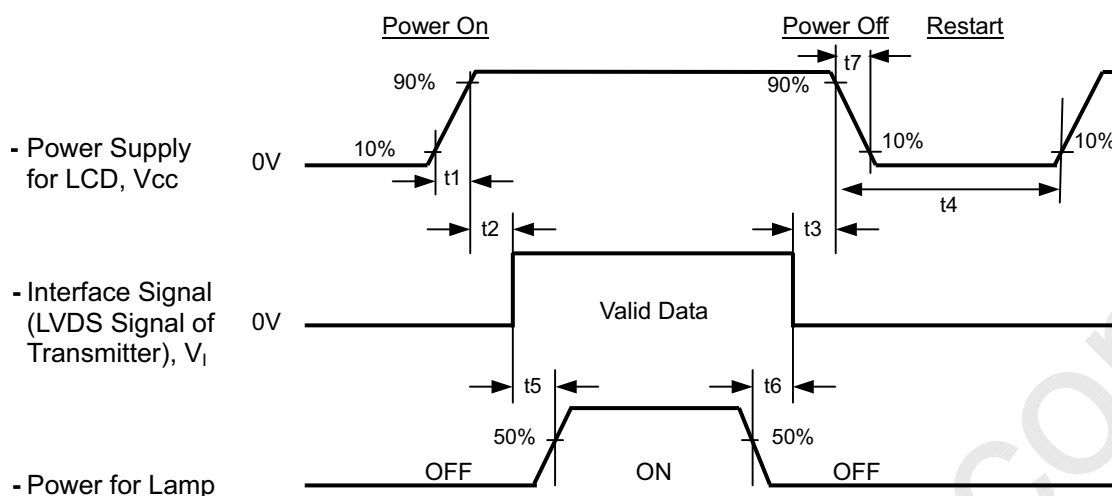
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The duration of DE signal must be longer than 1 clock period at every horizontal sync. period.

INPUT SIGNAL TIMING DIAGRAM



6.2 POWER ON/OFF SEQUENCE



Timing Specifications:

$$0.5 < t1 \leq 10 \text{ msec}$$

$$0 < t2 \leq 45 \text{ msec}$$

$$0 < t3 \leq 45 \text{ msec}$$

$$t4 \geq 400 \text{ msec}$$

$$t5 \geq 200 \text{ msec}$$

$$t6 \geq 200 \text{ msec}$$

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time had better to follow

$$t7 \geq 5 \text{ msec}$$

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

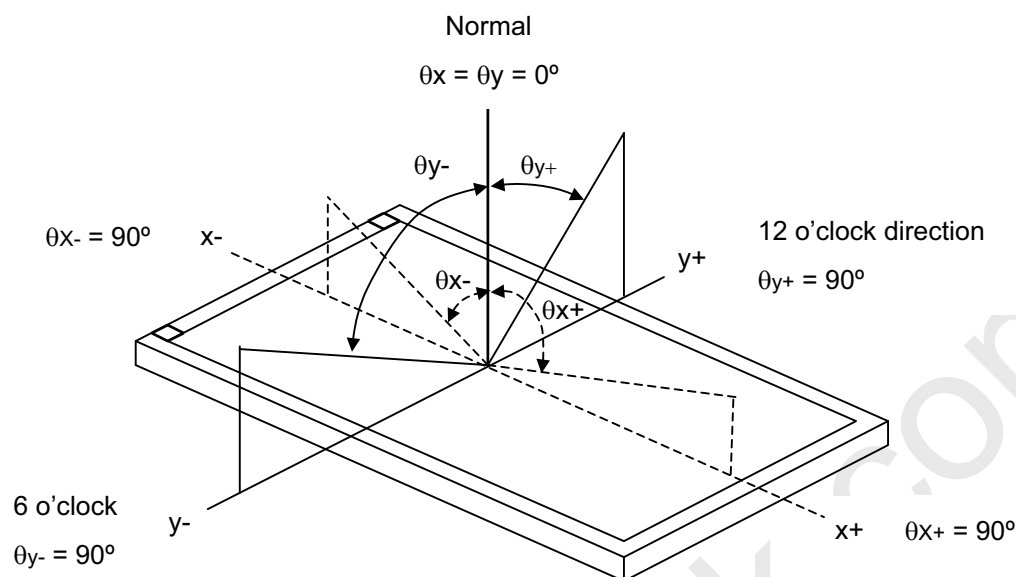
Item	Symbol	Value	Unit
Ambient Temperature	T _a	25±2	°C
Ambient Humidity	H _a	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I _L	6.5	mA
Inverter Driving Frequency	F _L	55	KHz
Inverter	Sumida-H05-4915		

The measurement methods of optical characteristics are shown in Section 7.2. The following items should be measured under the test conditions described in Section 7.1 and stable environment shown in Note (6).

7.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing Normal Angle	-	350	-	-	(2), (6)
Response Time		T _R		-	10	30	ms	(3)
		T _F		-	20	50	ms	
Central Luminance of White		L _{AVE}		150	175	-	cd/m ²	(4), (6)
White Variation		δW		-	-	1.4	-	(6), (7)
Cross Talk		CT		-	-	4	%	(5), (6)
Color Chromaticity	Red	R _x		0.571	0.601	0.631	-	(1), (6)
		R _y		0.305	0.335	0.365	-	
	Green	G _x		0.290	0.320	0.350	-	
		G _y		0.501	0.531	0.561	-	
	Blue	B _x		0.126	0.156	0.186	-	
		B _y		0.103	0.133	0.163	-	
	White	W _x		0.283	0.313	0.343	-	
		W _y		0.299	0.329	0.359	-	
Viewing Angle	Horizontal	θ _{x+}	CR≥10	-	45	-	Deg.	(1), (6)
		θ _{x-}		-	45	-		
	Vertical	θ _{y+}		-	15	-		
		θ _{y-}		-	35	-		

Note (1) Definition of Viewing Angle (θ_x , θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

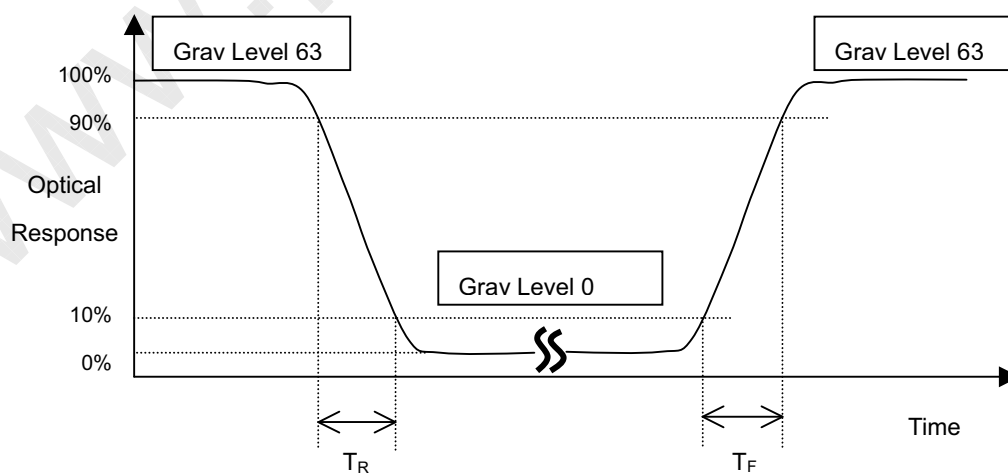
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (7).

Note (3) Definition of Response Time (T_R , T_F):



Note (4) Definition of Average Luminance of White (L_{AVE}):

Measure the luminance of gray level 63 at 5 points

$$L_{AVE} = [L(1) + L(2) + L(3) + L(4) + L(5)] / 5$$

$L(x)$ is corresponding to the luminance of the point X at Figure in Note (7).

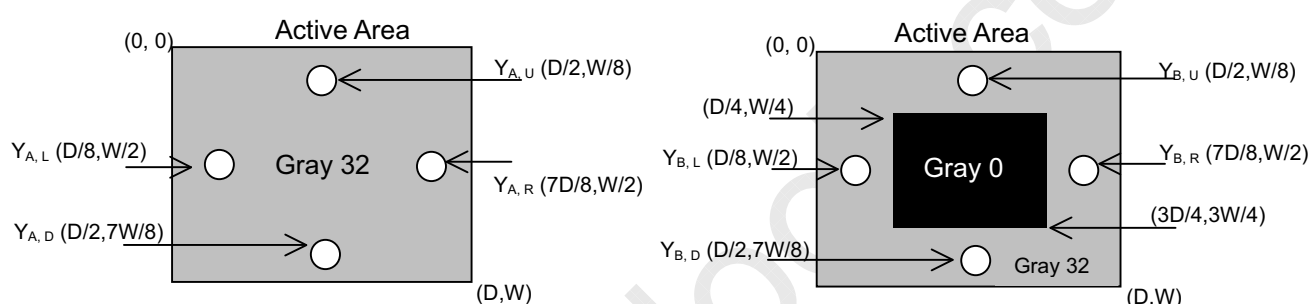
Note (5) Definition of Cross Talk (CT):

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

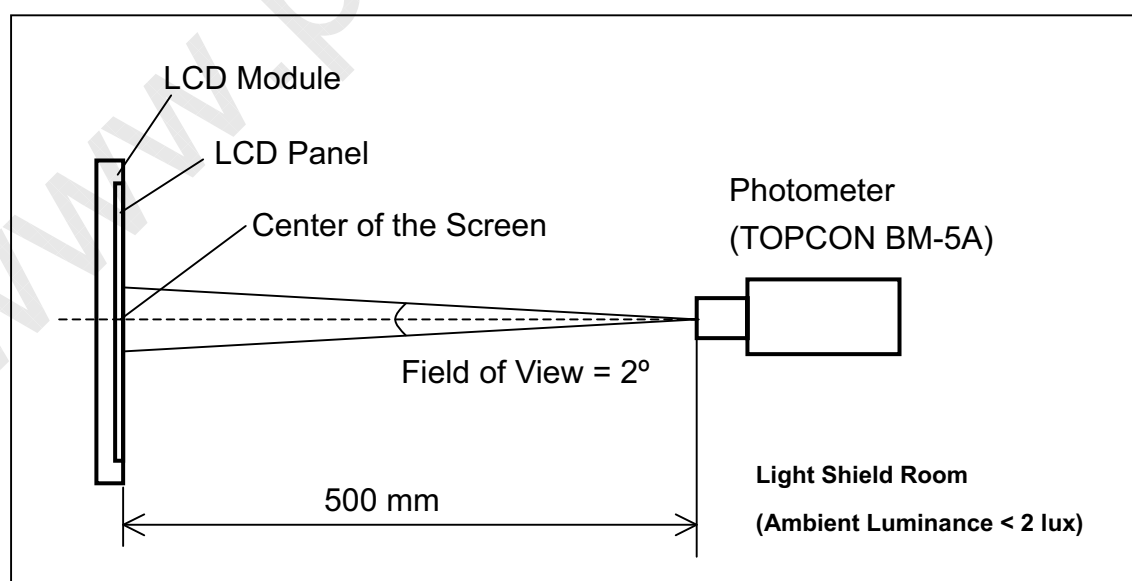
Where:

Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m^2)


Note (6) Measurement Setup:

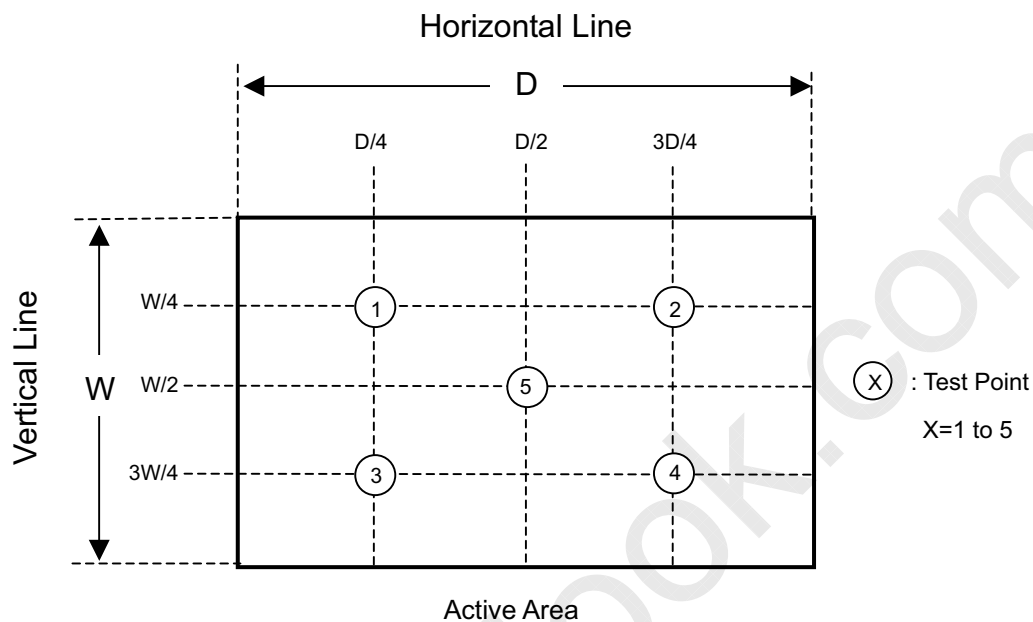
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 63 at 5 points

$$\delta W = \text{Maximum } [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum } [L(1), L(2), L(3), L(4), L(5)]$$



8. PRECAUTIONS

8.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the lamp wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

8.2 STORAGE PRECAUTIONS

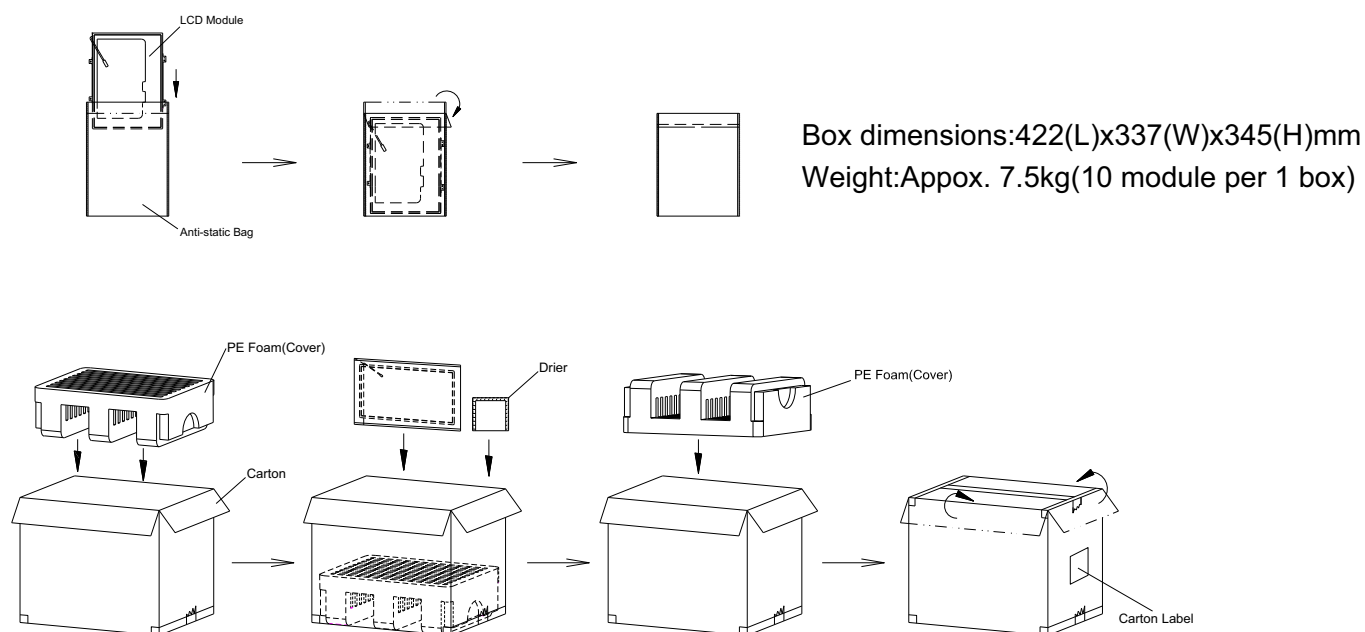
- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

8.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

9. PACKING

9.1 CARTON

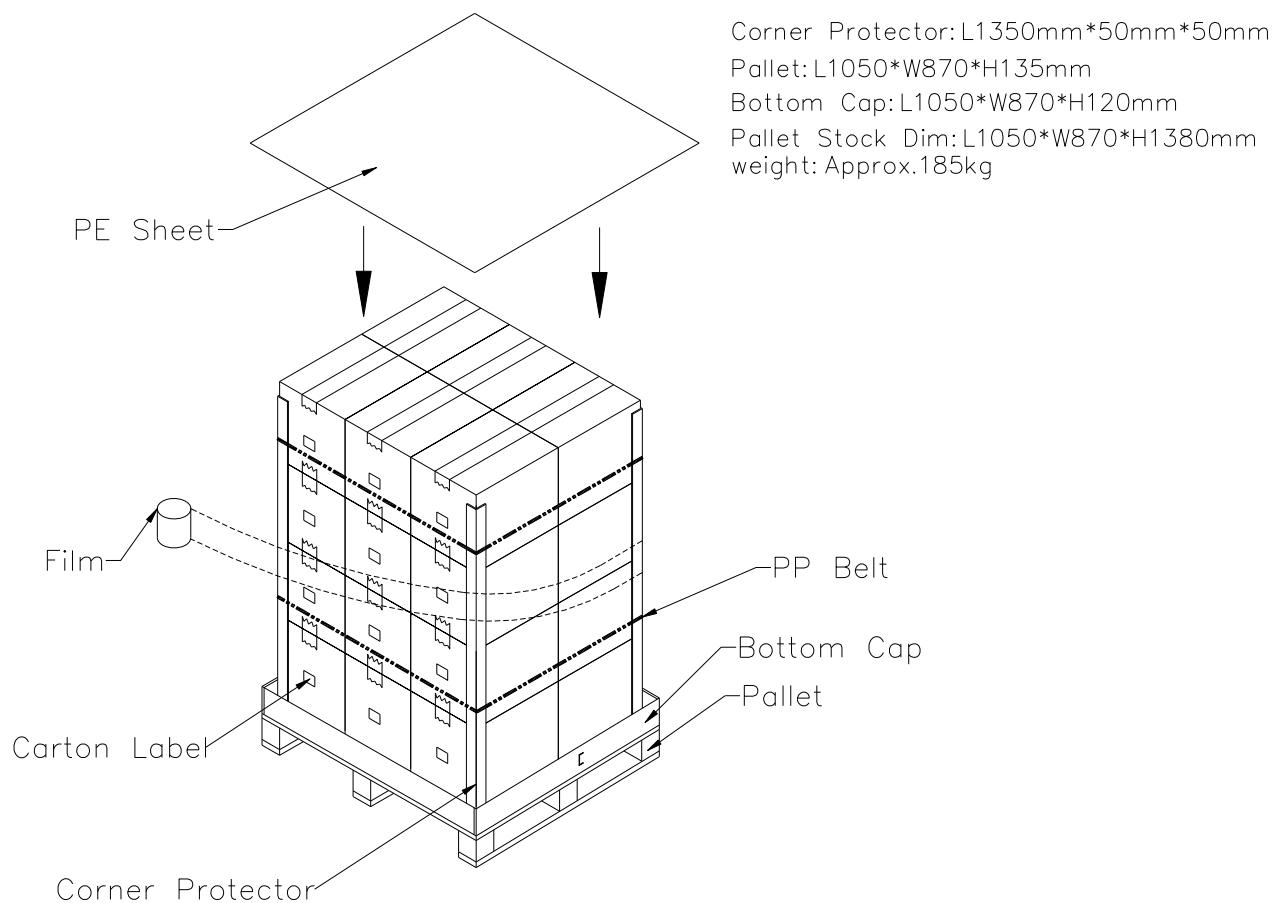


Packing testing criteria :

- (1) Packing drop : 1 corner, 3 edges, 6 faces, each direction for one time, follow ISTA standard.
- (2) Packing vibration : Random, follow ISTA standard.



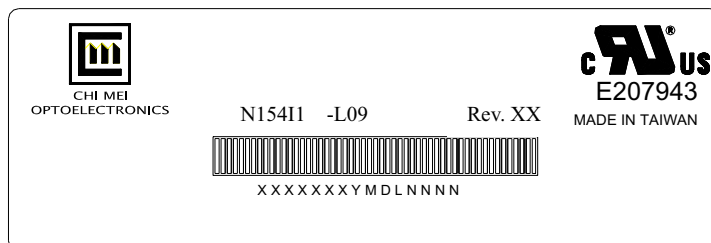
9.2 PALLET



10. DEFINITION OF LABELS

10.1 CMO MODULE LABEL

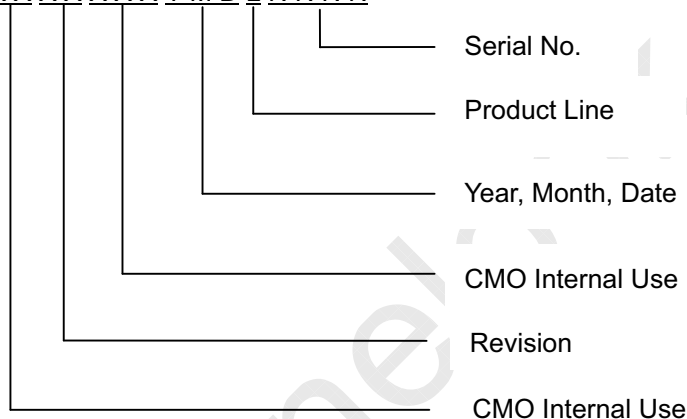
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N154I1 - L09

(b) Revision: Rev. XX, for example: C1, C2 ...etc.

(c) Serial ID: XXXXXX YMDL NNNN



Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

(d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.




Issued Date: Oct. 28, 2004
Model No.: N154I1-L09 (NF4I109901)

Approval

10.2 CARTON LABEL

The image shows a template for a carton label. It features a header section with the CHI MEI OPTOELECTRONICS logo and name. Below this, there are four lines of text for labeling: PO.NO., Part ID., Model Name, and Carton ID. The last line also includes a field for Quantities. The label is designed to be printed on a white background with a black border. A large, faint watermark 'www.panelook.com' is visible across the entire page.

 CHI MEI OPTOELECTRONICS	
PO.NO. _____	
Part ID. _____	
Model Name _____	
Carton ID. _____	Quantities _____

